CMR INSTITUTE OF TECHNOLOGY	USN										

Internal Assesment Test –I										
Sub:	**Introduction to Electrical Engineering**								Code:	***BESCK104B***
Date:	21-11-2024	Duration:	90 mins	Max Marks:	50	Sem:	1st sem		Branch:	Chem Cycle

Answer any FIVE FULL Questions--

		Marks	OBE CO	OBE RBT
1 a)	State and explain Ohm's law, List out its limitation.	[4]	CO1	L1

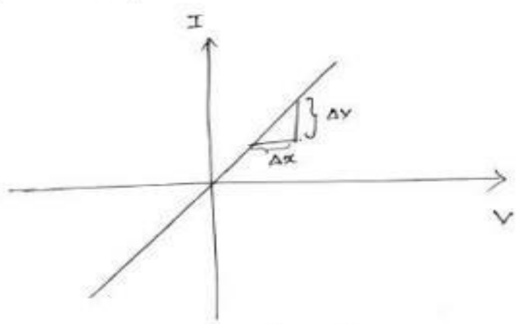
[illegible] law :-

The ratio of potential difference (V) between any two points on a conductor to the current (I) flowing between them is constant, provided the temperature of the conductor doesn't change.

$$\frac{V}{I} = \text{constant} = R(\Omega)$$

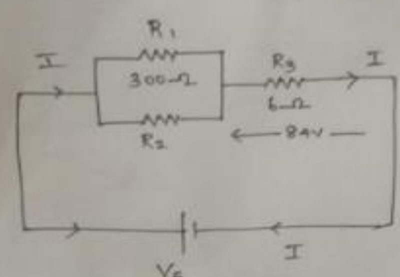
R - constant of proportionality
- resistance of the conductor.

Graphical representation of Ohm's law:



$$\text{Slope} = \frac{\Delta Y}{\Delta X} = \frac{I}{V} = \frac{1}{R} = G$$

where G is conductance (siemens) (℧).

<table>
<tr><td></td><td>Limitations - OHM'S LAW
1) It cannot be applied to non-linear devices like diodes, zener diodes, transistors, voltage regulator etc.
2) Ohm's law is applicable as long as temperature and other physical parameters remains constant
3) It cannot be applied to complicated ckts having more no of branches and emf sources
4) Not suitable for non-metallic conductors like silicon carbide, graphite etc.</td><td></td><td></td><td></td></tr>
<tr><td>b)</td><td>A DC circuit comprised two resistors R1 of value 300Ωand R2 of unknown value. The R1 and R2 are connected in parallel, together with the third resistor R3 of the value 6Ω connected in series with the parallel group. The P.D across R3 is 84V. If the total power in the circuit is 4312W, Calculate i) The value of R2 ii) The applied voltage to the ends of the whole circuit, and iii) The current in each resister.


Total Power = 4312 W
current thro R3 is same as supply current
$I = \frac{V}{R} = \frac{84}{6} \Rightarrow 14A$
$P_T = V_S I$; V_S - Supply voltage
$V_S = \frac{P_T}{I} = \frac{4312}{14} \Rightarrow 308V$
∴ Voltage across R_1 = $V_S - 84$ = Voltage across R_2
$= 308 - 84 \Rightarrow 224V$
current through $R_1 = \frac{224}{300} \Rightarrow 0.75A$.
current through $R_2 = I - 0.75 \Rightarrow 13.25A$
∴ $R_2 = \frac{224}{13.25} \Rightarrow 16.9 \simeq 17Ω$.</td><td>[6]</td><td>CO1</td><td>L3</td></tr>
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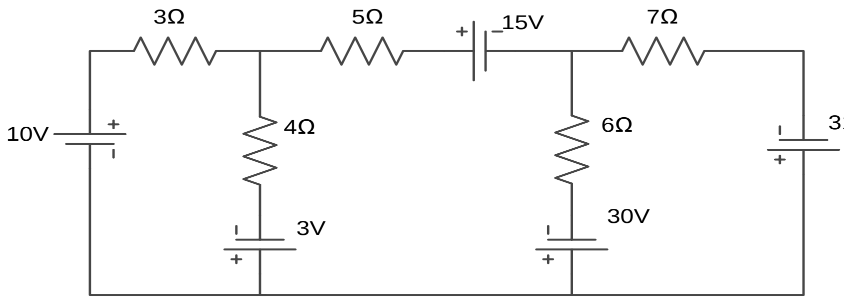
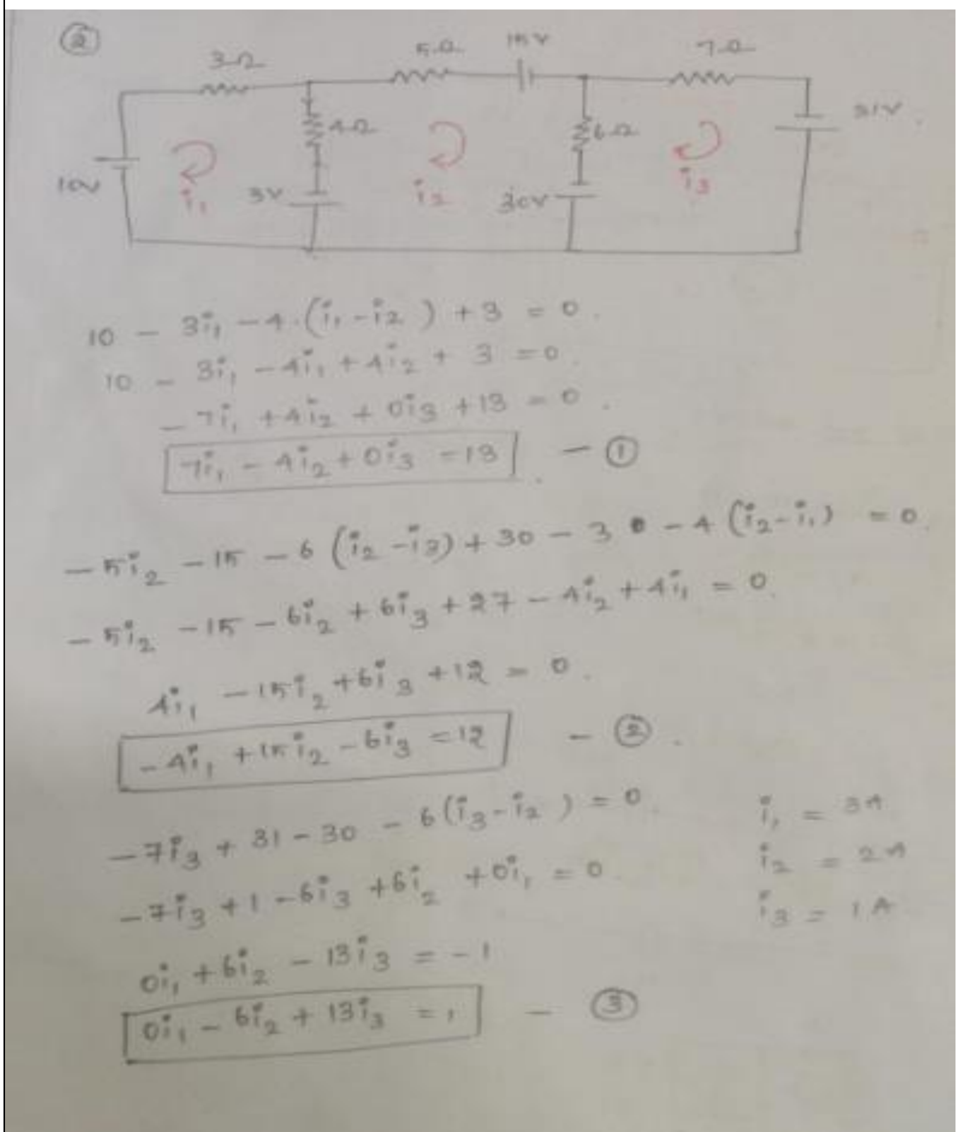
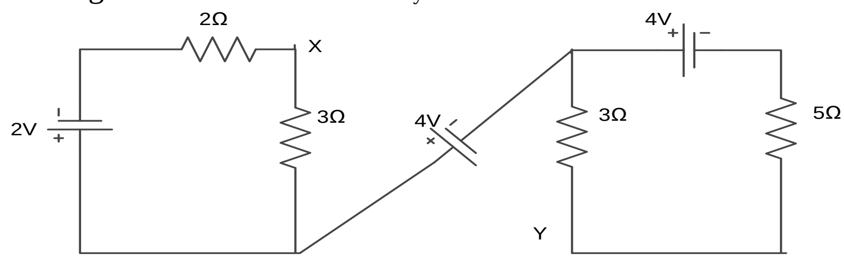
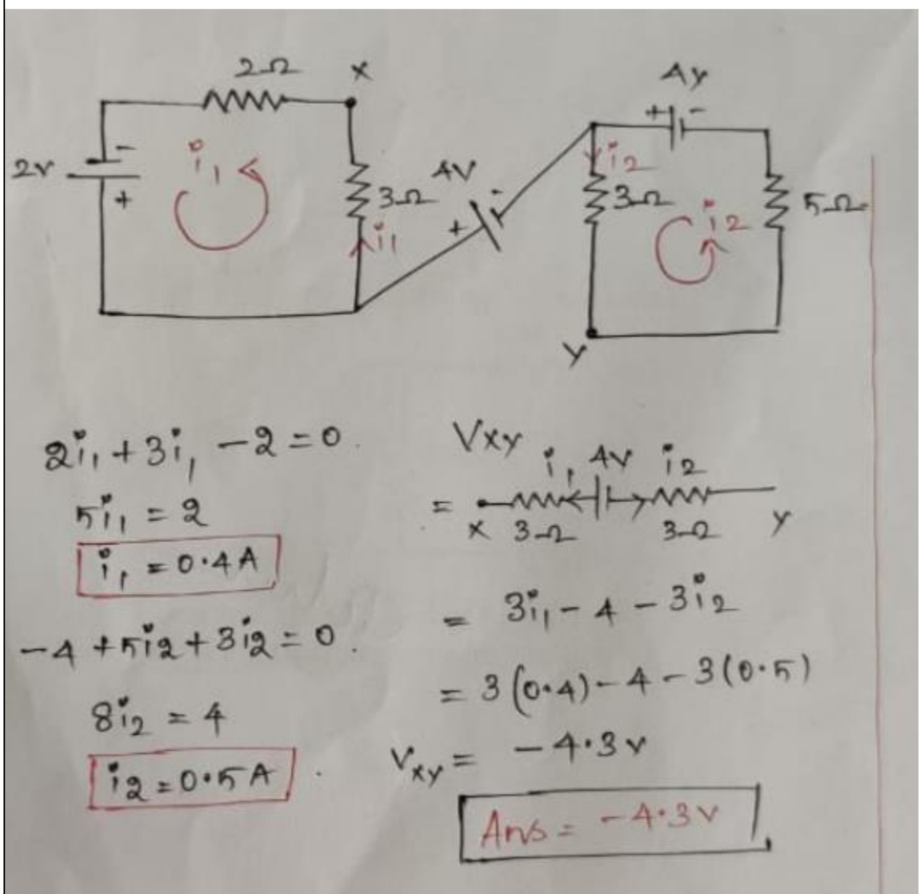
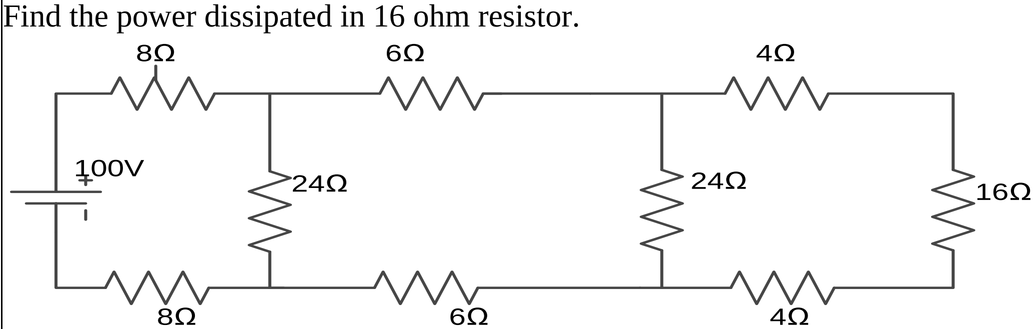
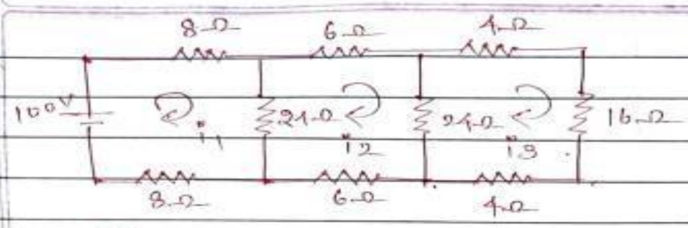
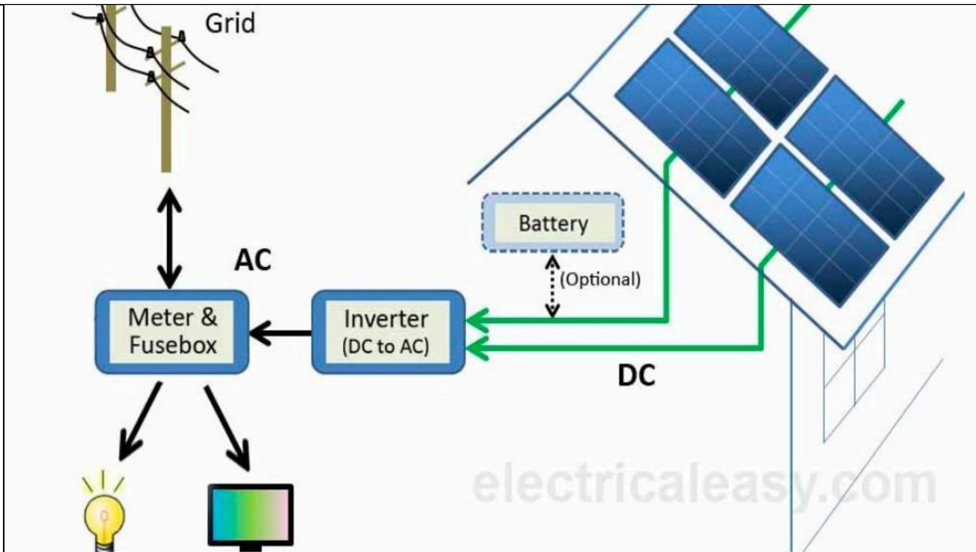
2 a)	Calculate the loop currents using KVL for the given circuit below?   (2) $10 - 3i_1 - 4(i_1 - i_2) + 3 = 0$ $10 - 3i_1 - 4i_1 + 4i_2 + 3 = 0$ $-7i_1 + 4i_2 + 0i_3 + 13 = 0$ $7i_1 - 4i_2 + 0i_3 = 13$ — (1) $-5i_2 - 15 - 6(i_2 - i_3) + 30 - 3 - 4(i_2 - i_1) = 0$ $-5i_2 - 15 - 6i_2 + 6i_3 + 27 - 4i_2 + 4i_1 = 0$ $4i_1 - 15i_2 + 6i_3 + 12 = 0$ $-4i_1 + 15i_2 - 6i_3 = 12$ — (2) $-7i_3 + 31 - 30 - 6(i_3 - i_2) = 0$ $-7i_3 + 1 - 6i_3 + 6i_2 + 0i_1 = 0$ $0i_1 + 6i_2 - 13i_3 = -1$ $0i_1 - 6i_2 + 13i_3 = 1$ — (3) $i_1 = 3A$ $i_2 = 2A$ $i_3 = 1A$	[6]	CO1	L3

b)	For the given circuit calculate V_{xy}   	[4]	CO1	L3
3 a)	Find the power dissipated in 16 ohm resistor.  	[5]	CO1	L3

	8 a)  KVL @ L1, $-8i_1 - 24(i_1 - i_2) - 8i_1 + 100 = 0$ $-8i_1 - 24i_1 + 24i_2 - 8i_1 = -100$ $-40i_1 + 24i_2 + 0i_3 = -100$ — (1) KVL @ L2, $-6i_2 - 24(i_2 - i_3) - 6i_2 - 24(i_2 - i_1) = 0$ $-6i_2 - 24i_2 + 24i_3 - 6i_2 - 24i_2 + 24i_1 = 0$ $24i_1 - 60i_2 + 24i_3 = 0$ — (2) KVL @ L3, $-4i_3 - 16i_3 - 4i_3 - 24(i_3 - i_2) = 0$ $-4i_3 - 16i_3 - 4i_3 - 24i_3 + 24i_2 = 0$ $0i_1 + 24i_2 - 48i_3 = 0$ — (3) Solving above equations, $i_1 = 3.57$ A $i_2 = 1.78$ A $i_3 = 0.89$ A. Current through 16Ω resistor is i_3 ∴ Power dissipated $= i_3^2 \times 16$ $= 0.89^2 \times 16$ $= 12.67$ W $P = 12.67$ W.			
b)	With the help of a neat block diagram explain Solar Power Generation.	[5]	CO5	L1



Solar power generation is the process of converting sunlight into electricity. This is done through the use of solar panels, which capture the energy from the sun and convert it into usable electricity. The basic components of a solar power generation system include: Solar Panels: Solar panels are made up of photovoltaic cells, which convert sunlight into direct current (DC) electricity. They are typically installed on rooftops or in fields where they can be exposed to the maximum amount of sunlight.

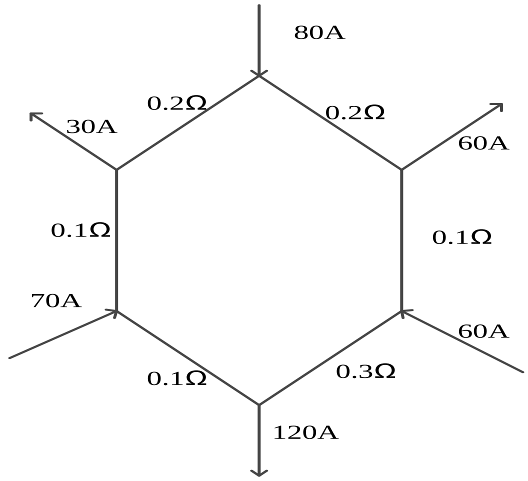
Inverter: The inverter is used to convert the DC electricity produced by the solar panels into alternating current (AC) electricity, which can be used to power appliances and equipment.

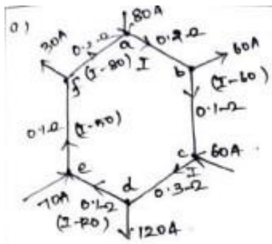
Battery Storage: Solar power generation systems can be equipped with batteries to store excess electricity generated during the day for use at night or during periods of low sunlight.

Monitoring System: A monitoring system is used to track the performance of the solar power generation system and identify any issues that may arise. Solar power generation has several advantages over conventional energy sources, including: Renewable: Solar power is a renewable energy source that will never run out. Environmentally Friendly: Solar power generation produces no greenhouse gas emissions and has a minimal impact on the environment.

Cost-Effective: The cost of solar power generation has decreased significantly in recent years, making it more accessible to homeowners and businesses. However, solar power generation also has some limitations, such as its dependence on sunlight and its intermittent nature, which means that energy storage solutions are needed to ensure a consistent supply of electricity. Additionally, the initial cost of installing solar panels can be high, although this is often offset by long-term savings on electricity bills

<table>
<tr><td>4 a)</td><td>For the given circuit , calculate current through all the branches





Let us assume current through branch ab, be I (A). Applying KCL at remaining nodes, the current through all other branches are written as follows

$I_{ab} = I(A)$; $I_{bc} = (I - 60)\,A$; $I_{cd} = I(A)$; $I_{de} = (I - 120)\,A$

$I_{ef} = (I - 50)\,A$; $I_{fa} = (I - 80)\,A$.

Apply KVL for the loop abcdefa,

$-0.2I - 0.1(I-60) - 0.3I - 0.1(I-120) - 0.1(I-50)$
$- 0.2(I-80) = 0.$

$-0.2I - 0.1I + 6 - 0.3I - 0.1I + 12 - 0.1I + 5 - 0.2I + 16 =$

$I - 39 = 0$

$\boxed{I = 39\,A}$

$I_{ab} = 39A$; $I_{bc} = 39 - 60 = -21A$; $I_{cd} = 30A$

$I_{de} = I - 120 = 39 - 120 = -81A$; $I_{ef} = -11A$;

$I_{fa} = -41A$.</td><td>[5]</td><td>CO1</td><td>L3</td></tr>
<tr><td>b)</td><td>State and explain Kirchhoff’s Laws, as applied to D.C. Circuit.

The current or voltage of any circuit branch can also be calculated using Kirchhoff's Law. These laws are valid in AC and DC networks at low frequencies.</td><td>[5]</td><td>CO1</td><td>L2</td></tr>
</table>

Kirchhoff's laws are classified into two types:

- Kirchhoff's Current Law (KCL)
- Kirchhoff's Voltage Law (KVL)

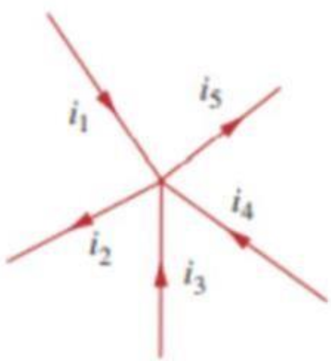
Kirchhoff's Current Law

Kirchhoff's current law is also known as Kirchhoff's First law or Kirchhoff's Law of the junction, but the most used term is Kirchhoff's Current Law or KCL. KCL is based on the law of conservation of charge.

Kirchhoff's current law states that the algebraic sum of currents entering a node or a closed boundary equals zero.

If there are N number of branches connected to a node and it is the current of the nth branch, then mathematically, KCL states,

$^{N}\sum_{n=1} i_n = 0$



Applying KCL to the above node,

$$-i_1 + i_2 - i_3 - i_4 + i_5 = 0$$

$$i_2 + i_5 = i_1 + i_3 + i_4$$

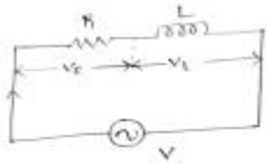
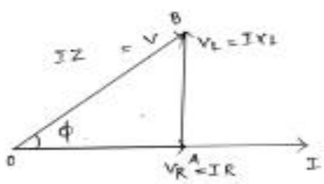
Current leaving=current entering

Kirchhoff's Voltage Law

Kirchhoff's Voltage Law is also known as Kirchhoff's Second law or KVL. KVL is based on the law of conservation of energy.

Kirchhoff's Voltage Law:

Kirchhoff's Voltage Law states that the algebraic sum of voltages around a closed path or loop

	in a circuit equals zero. If there are M number of voltages in a loop and V_m is the m^{th} voltage, then mathematically, KVL can be written as: $\sum_{n=1}^{M} V_m = 0$			
5	Derive expression for current flowing through a Series R-C circuit and R-L circuit, when an alternating e.m.f. $v(t) = Vm\ sin(\omega t)$volts is applied across it with a neat waveform. RL Series circuit  Let V - rms value of the applied voltage I - rms value of the applied current $V_R = IR$ (V_R in phase with I) $V_L = IX_L$ (V_L leads I by 90). Take that quantity as reference which is common in the ckt.  $\vec{V} = \vec{V_R} + \vec{V_L} \Rightarrow \sqrt{V_R^2+V_L^2}$ $= \sqrt{(IR)^2 + (IX_L)^2}$ $= I\sqrt{R^2+X_L^2}$ $I = \dfrac{V}{\sqrt{R^2+X_L^2}} \Rightarrow \dfrac{V}{Z}$ where $Z = \sqrt{R^2+X_L^2}$ is the impedance of the ckt which offers opposition to current flow.	[10]	CO2	L2

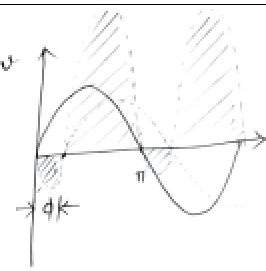
Phase angle :-

$Z = \sqrt{R^2 + X_L^2}$

$Z = R + jX_L$

$\tan\phi = \frac{V_L}{V_R} = \frac{IX_L}{IR}$

$\tan\phi = \frac{X_L}{R}$



i.e $v = V_m \sin \omega t$

$i = I_m \sin(\omega t - \phi)$.

i.e in an inductive circuit, current lags behind the applied voltage by ϕ.

Power :- Instantaneous power $p = vi$

$= V_m \sin \omega t \times I_m \sin(\omega t - \phi)$

$= V_m I_m \sin \omega t \sin \omega t - \phi$

$\sin A \sin B = \frac{1}{2}[\cos(A-B) - \cos$

$= \frac{V_m I_m}{2}[\cos(\omega t - \omega t + \phi) - \cos(\omega t + \omega t - \phi)]$

$= \frac{V_m I_m}{2}(\cos\phi - \cos(2\omega t - \phi))$

$= \frac{V_m I_m \cos\phi}{2} - \frac{V_m I_m \cos(2\omega t - \phi)}{2}$

↓ Const part whose avg value is same

↓ fluctuating part whose avg value is zero.

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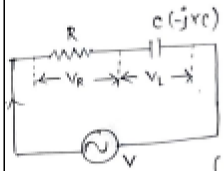
RC Series circuit



V – rms value of applied voltage
I – rms value of circuit current

Phasor diagram

$V_R = IR$ (V_R in phase with I)

$V_C = IX_C$ (V_C lags I by 90)

using KVL, $\vec{V} = \vec{V_R} + \vec{V_C}$ – ①

$|V| = \sqrt{V_R^2 + V_C^2}$ – ②

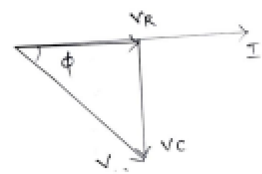
$= \sqrt{(IR)^2 + (IX_C)^2}$

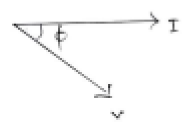
$V = I\sqrt{R^2 + X_C^2}$ – ③

$V = IZ$

where $|Z| = \sqrt{R^2 + X_C^2}$ – ④

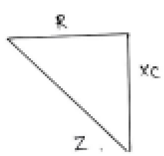
↓ impedance – opposition to current flow.

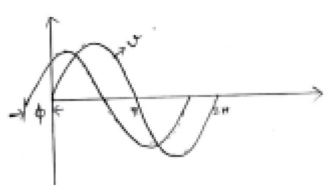




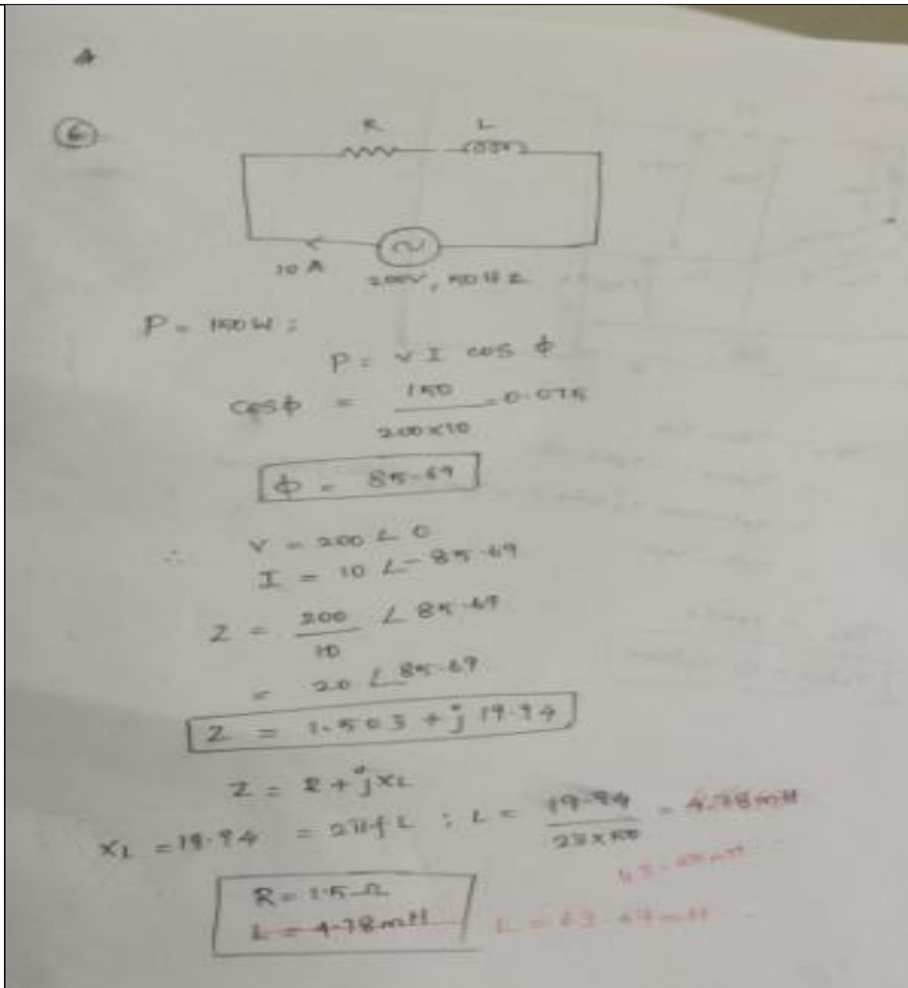
Impedance triangle

$Z = R - jX_C$.





</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>A coil is connected across a 200V, 50Hz ac supply takes the current of 10A, the power dissipated across the coil is 150W. find the value of R & L of the coil.</td><td>[10]</td><td>CO2</td><td>L3</td></tr>
</table>

				
7	Define the RMS, average value, form factor and peak factor for a sinusoidal signal. **Average Value:** The average of all the instantaneous values of an alternating voltage and currents over one complete cycle is called **Average Value.**If we consider symmetrical waves like sinusoidal current or voltage waveform, the positive half cycle will be exactly equal to the negative half cycle. Therefore, the average value over a complete cycle will be **zero**. **RMS Value:** That steady current which, when flows through a resistor of known resistance for a given period of time than as a result the same quantity of heat is produced by the alternating current when flows through the same resistor for the same period of time is called **R.M.S** or effective value of the alternating current. **Peak Factor** is defined as the ratio of maximum value to the R.M.S value of an alternating quantity. The alternating quantities can be voltage or current. The maximum value is the **peak value** or the **crest value** or the amplitude of the voltage or current. **Form Factor:**	[10]	CO2	L1

	The ratio of the root mean square value to the average value of an alternating quantity (current or voltage) is called Form Factor. The average of all the instantaneous values of current and voltage over one complete cycle is known as the average value of the alternating quantities.			

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